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LMA790-3-LM 10 and Subsequent

APOLLO OPERATIONS HANDBOOK LUNAR MODULE LM 10 AND SUBSEQUENT

VOLUME I SUBSYSTEMS DATA

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NAS 9-1100 Exhibit E Paragraph 10.4

TYPE I DOCUMENT

Prepared under direction of

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
PACECRAFT SYSTEMS BRANCH / FLIGHT CREW SUPPORT DIVISION

THIS PUBLICATION SUPERSEDES LMA790-3-LM 8 AND SUBSEQUENT DATED 15 JUNE 1970



LM PUBLICATIONS SECTION / PRODUCT SUPPORT DEPARTMENT / GRUMMAN AEROSPACE CORPORATION / BETHPAGE / NEW YORK

ABBREVIATION LIST

	A		C (cont)
A/D	Analog-to-digital	cb	Circuit breaker
AAP	Abort autopilot	CBW	Constant bandwidth
abs	Absolute	CBX	C-band transponder
ac (a-c)	Alternating current	CCRD	Computer control and reticle dimr
ACA	Attitude controller assembly		assembly
AEA	Abort electronics assembly	CDH	Constant delta altitude
AEAA	Ascent engine arming assembly	CDR	Commander
AELD	Ascent engine latching device	CDU	Coupling data unit
AF	Audio frequency	CENTANG	Central angle of transfer
AFC	Automatic frequency control	CES	Control electronics section
AGC	Automatic gain control	CFP	Coelliptic flight plan
AGS	Abort guidance section	cg	Center of gravity
ALT	Altitude	CKT	Circuit
mp	Ampere(s)	CL	Close
MPL	Amplifier	CLR	Clear
INT	Antenna	CMC	Command module computer
NUN	Annunciator	CMD(S)	Command(s)
TO	Alignment optical telescope	CMPTR	Computer
APS	Ascent propulsion section	COAS	
AR	AOT reticle angle	COMM	Crewman optical alignment sight
ARS	Atmosphere revitalization section	COMP	Communications
17.53 14.53	AOT shaft angle		Comparator
ASA		CONDR	Conditioner
	Abort sensor assembly	CONT	Control
ASC	Ascent	cont	continued
ASD	Apollo standard detonator	cos	Cosine
ASI	Apollo standard initiator	co_2	Carbon dioxide
ASSY	Assembly	$CP\overline{L}$	Couple
AT .	AOT trunnion angle	cps	Cycles per second
ATA	Abort timing assembly	CPS	Cold plate section
ATCA	Attitude and translation control	CRSFD	Crossfeed
	assembly	CS	Communications Subsystem
TM	Altimeter transmitter multiplier	CSI	Coelliptic sequence initiation
TT	Attitude	CSM	Command and Service module
TTEN	Attenuator	CSS	Computer subsection
UTO	Automatic	CT	Control transformer
.UX	Auxiliary	CTR	Counter reset
		CTS	Counter set
	В	CW	Continuous wave
		CWEA	Caution and warning electronics
AL	Balance		assembly
AT	Battery	CX	Control transmitter
D	Band		Out of transmitter
iomed	Biomedical		D
IPRPLNT	Bipropellant		B
PF	Band-pass filter	D1, 2,	
Ū	Backup	3, 4	Doppler spectrum signals
•	Duchup	D/A	Digital-to-analog
	С	DAP	Digital-to-analog Digital autopilot
	V	db	Digital autophot Decibel
W/FM	Continuous wave frequency-	dc (d-c)	
** / A 171	modulated		Direct current
_	caution and warning	DCA DECA	Digital command assembly Descent engine control assembly
/W		1 1 P. 1 AA	LIBERGATE ARGIDA AANTRAL AAAAMAIN

ABBREVIATION LIST (cont)

	D (cont)		F (cont)
DECR	Decrease	FM	Enormone and July
DEDA	Data entry and display assembly	FR	Frequency modulation Range frequency
DEG	Degree(s)	FOV	Field-of-view
DEMOD	Demodulator	fps	Foot (feet) per second
DES	Descent	ft	Foot (feet)
DET	Detector	FWD	Forward
DFI	Developmental Flight Instrumen-		·· ·
DED	tation		G
DFR	Deadface relay		
DID DIF	Display inertial data (discrete)	g	Gravity
DISP	Differential	GASTA	Gimbal angle sequencing transfor-
DIST	Display Distribution		mation assembly
DN	Down	gc	Gigacycle(s)
DNKRPT	Downlink interrupt	GDA	Gimbal drive actuator
DPS	Descent propulsion section	GEN GET	Generator
DRB	Deadface relay box	GETI	Ground elapsed time
DSEA	Data storage electronics assembly	GMBL	Ground elapsed time of ignition Gimbal
DSKY	Display and keyboard	GN&CS	Guidance, Navigation, and Control
DUA	Digital uplink assembly	-1.202	Subsystem
DVS	Doppler velocity sensor	GOX	Gaseous oxygen
		GRD	Ground
	E	GSE	Ground support equipment
12	TN4'-	GUID	Guidance
E	Elevation angle		
ECA ECI	Electrical control assembly		Н
ECS	Electrical circuit interrupter		
ED	Environmental Control Subsystem Explosive device	H/X	Heat exchanger
EDC	End detonator cartridge	h 	Altitude
EDS	Explosive Devices Subsystem	h Uo	Altitude rate
EKG	Electro-cardiograph	Ha He	Apogee
EL	Electroluminescent	HEA	Helium
EMI	Electromagnetic interference	HF	High-efficiency antireflection High frequency
EMP	Emphasis	Hg	Mercury
EMU	Extravehicular mobility unit	HÏ	High
ENG	Engine	HNDRPT	Hand interrupt
ENTR	Enter	H _p	Perigee
EOS	Emergency oxygen system	HŤF	High-pass filter
EPS	Electrical Power Subsystem	HTR	Heater
ERA	Electronic replaceable assembly	HTS	Heat transport section
ERR EVA	Error	HV	High voltage
EVVA	Extravehicular astronaut	H ₂ O	Water
EX	Extravehicular visor assembly X-component of attitude error		
E _Y	Y-component of attitude error		4
EZ	Z-component of attitude error	IAM	Total A.
	= 55ponom or attitude error	ICS	Incidental amplitude modulation
	F	ID	Intercommunication system Identification
		ĪF	Intermediate frequency
F	Fahrenheit; forward	ĪĠA	Inner gimbal axis
FC	LR tracker reference frequency	IMU	Inertial measurement unit
FDAI	Flight director attitude indicator	INCR	Increase
FDBK	Feedback	INV	Inverter
FF	Flip-flop	IOPS	Interim Oxygen Purge System
FITH	Fire in the hole	IRIG	Inertial reference integration gyro

Mission LM Basic Date 1 February 1970 Change Date

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ABBREVIATION LIST (cont)

relay LOS Line of sight OPR Operate LPD Landing point designator OPR ERR Operator error LPF Low-pass filter ORDEAL Orbital rate display - earth an lunar LSD Least significant digit OSC Oscillator LTG Lighting OSCPCS Oxygen supply and cabin pressor LUT Launch umbilical tower control section LV Low voltage OSS Optical subsection M OVBD Overboard OVHD Overhead M Mode discrete OXID Oxidizer MALF Malfunction O2 Oxygen MAN Manual MANF Manifold P max Maximum mc Megacycle(s) MF Medium frequency P-P Peak-to-peak MF Medium feed contactor OPR CAMP Operator OPR CRAPH OPR OPR Operator OPR CRAPH OPR OPR OPR OPR OPR OPR OPR OPR O	Isolation Specific impulse Miscellaneous		I (cont)		M (cont)
IS Specific impulse Inertial subsection Integrated Thermal micrometeroid garment MON Monitor Monitor M	Sectific impulse MKRPT Mark interrupt Millimeter(s) Modulation MoD Modulation Modulation MoD Modulation MoD Modulation MoD Modulation Modulation MoD Modulation Modul		Instrumentation Subsystem	min	Minimum
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	Sission LM Basic Date 1 February 1970 Change Date Page A-3	NOA.	widdle gimbar axis	PAM	Pulse amplitude modulation
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ABBREVIATION LIST (cont)

	P (cont)		R (cont)
PBAT	Pyro battery	RC	Resistance-capacitance
PBW	Proportional bandwidth	RCCA	Rough combustion cutoff assembly
PCA	Program coupler assembly	RCR	Reverse-current relay
PCM	Pulse code modulation	RCS	Reaction Control Subsystem
PCMTEA	Pulse-code-modulation and timing	RC VR	Receiver
	electronics assembly	RD	Relay driver
PDA	Power distribution assembly	RDG	Range data good
PGA	Pressure garment assembly	RDNG	Range data no good
PGNCS	Primary guidance, navigation, and	RDR	Radar
DOMO	control section	\mathbf{REF}	Reference
PGNS	Primary guidance and navigation	REG	Regulator
PIP	section	RES	Resolver
PIPA	Pulse integrating pendulum	RET	Return
FIFA	Pulsed integrating pendulous accelerometer	RF	Radio frequency
PKG	Package	r _f	Radial rate
PLSS	Portable life support system	RGA RH	Rate gyro assembly
PM	Phase modulation	RJB	Right hand
PMP	Premodulation processor	rms	Relay junction box Root mean square
ppm	Pulse(s) per minute	RNDZ	Rendezvous
pps	Pulse(s) per second	RNG	Range
PQGS	Propellant quantity gaging system	ROD	Rate of descent
PRA	Program reader assembly	RR	Rendezvous Radar
PRE	Program reader electronics	RRE	Rendezvous radar electronics
PRESS	Pressure	RT	Resistance thermometer
PRF	Pulse repetition frequency	RUPT	Interrupt
PRIM	Primary	RZ	Return-to-zero
PRM	Pulse ratio modulator		
PRN PRPLNT	Pseudorandom noise Propellant		S
PS	Power Supply	C. M	Giran al
PSA	Power and servo assembly	S+N S/S	Signal + noise
psi	Pound(s) per square inch	S&C	Subsystem
psia	Pound(s) per square inch absolute	SBASI	Stabilization and control
psid	Pound(s) per square inch differen-	DDADI	Single bridgewire Apollo standard initiator
•	tial	SBPA	S-band power amplifier
PSK	Phase-shift keyed	SBX	S-band transponder
PT	Pressure transducer	SC	Signal conditioner
PTA	Pulse torque assembly	SCEA	Signal-conditioning electronics
PTT	Push-to-talk		assembly
PVT	Pressure-volume-temperature	SCERA	Signal conditioner electronic
PWR	Power		replaceable assembly
	^	SCO	Signal-controlled oscillator
	Q	SE	Systems Engineer
Q	Quotient	sec	Second(s); secondary
QI	Quantity indicator	SEL	Select
QTY	Quantity	SENS	Sensitivity
quad	Quadrant	SEP SEQ	Separator
QUAD	Quodrature	SERVO-	Sequence
•	•	AMPL	Servoamplifier
	R	SG	Signal generator
		SHe	Supercritical helium
R1, 2, 3	DSKY registers 1, 2, and 3	SHFT	Shaft
R	Rankine; right	SIG	Signal
R/C	Reverse current	sin	sine

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ABBREVIATION LIST (cont)

	S (cont)		ŭ
SLA	Spacecraft Lunar Module adapter	UDMH	Unsymmetrical dimethylhydrazine
SMRD	Spin motor rotation detector	UHF	Ultrahigh frequency
SOL	Solenoid	UPRUPT	Uplink interrupt
SOM	Stable orbit midcourse	usec	Microsecond(s)
SOR	Stable orbit rendezvous		• ,
SOV	Shutoff valve		**
SP	Static pressure		V
SPA	Signal-processing assembly		
SPDT	Single-pole double-throw	V	Verb
SRR	Shift-register reset	vac	Volts, alternating current
SRS.	Shift-register set	VCO	Voltage-controlled oscillator
SS	Speed sensor	v_{cx}	X-component of CSM velocity
SSB	Single sideband	v_{cy}	Y-component of CSM velocity
ST	Strain/temperature signal	$\mathbf{v_{cz}}$	Z-component of CSM velocity
CTAD/CONT	conditioner	VĎ	Velocity data
STAB/CONT STBY	Stabilization and control	vdc	Volts, direct current
SW	Standby Switch	VDG	Velocity data good
SYS	System	VDNG	Velocity data no good
313	System	VEL	Velocity
		VG	Magnitude of velocity to be
	T	VGPS	gained
		VHF	Vehicle ground power supply
T/R	Transmitter-receiver	VLV	Very high frequency Valve
TΔ	Time to go until CDH maneuver	VOL	
TAI	Absolute time	VOX	Volume
TBS	To be supplied	VPI	Voice-operated relay
tf	Time of flight from tig until target	vrms	Valve position indicator
4	is reached	VSOM	Volts root mean square Velocity sensor oscillator
Tig	Time of ignition	4001/1	multiplier
T_N	Trim negative	v_x	X-component of LM velocity
TP	Trim positive	vx	Altitude rate (landing radar)
TĈ	Thermocouple	V _{xa} Vy V _{ya} V _z	Y-component of LM velocity
TCA	Thrust chamber assembly	V _{va}	Laterial velocity (landing radar)
TE	Timing electronics equipment	$V_z^{j\alpha}$	Z-component of LM velocity
TEMP	Temperature	v_{za}^{z}	Forward velocity (landing radar)
TFF	Time of free fall to 3,000 ft	24	, (,
TFI	Time from Tig		w
THR	Thrust		
TL	Tracker look-on	W/B	Water boiler
TLE	Tracking light electronics	WC	Weighted current
TM	Telemetry	WCG	Weighted current gate
TPF	Transfer phase final	WMS	Water management section
TPI	Transfer phase initiation		
TPM	Transfer phase midcourse		X
TRANSL	Translation		_
TRUN	Trunnion	XLUNAR	Translunar
TS TT	Temperature sensor	XMTD	Transmitted
TT	Temperature transducer Thrust/translation controller	XMTR	Transmitter
TTCA	Thrust/translation controller	XPNDR	Transponder
TTI	assembly Time to initiate	XTAL	Crystal
TTIg	Time to initiate Time to ignition	<i>)</i>	Anala
TV	Television	*	Angle
TX	Telemetry transmitter	Δh	Altitude differential
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ABBREVIATION LIST (cont)

	X (cont)		X (cont)
$\Delta \mathbf{P}$	Pressure differential	$\Delta V_{\mathbf{m}}$	Measured ΔV magnitude
ΔR	Magnitude of difference between	Δφc	Gimbal angle change command
	position state vectors before and	Δøg	Change in gimbal angle
	after incorporation of mark data	ø	Phase
Δro	Differential altitude in co-elliptic	Σ	Sum (summing)
	orbit	1 X	One-speed resolver
ΔV	Velocity change (differential)	16 X	Sixteen-speed resolver

2.9.4.5 <u>Data Storage Electronics Assembly</u>. (See figure 2.9-16.)

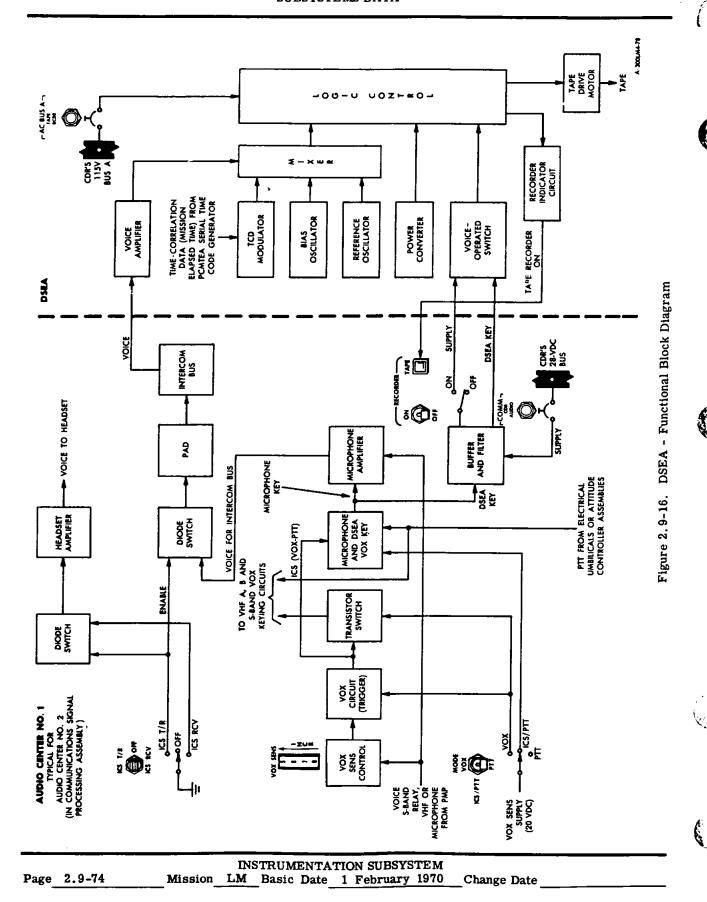
The DSEA is a single-speed, four-track, magnetic-tape recorder that stores voice and time-correlation data (TCD) (mission elapsed time). A maximum of 10 hours of recording time is provided (2.5 hours on each track) by driving the tape in one direction over the record head and, on completion of a pass, switching to the next track and reversing tape direction. The tape is supplied in a magazine, consisting of a supply reel and takeup reel. Once the magazine is properly placed in the DSEA and the control logic is placed in track No. 1 forward condition (reset), the DSEA is operated with the RECORDER switch on the COMMUNICATIONS portion of panel 12 in conjunction with the VOX trigger signal supplied by the signal-processing assembly (SPA) of the CS.

The DSEA operates in either a manual or semiautomatic mode. In the manual mode, the ICS T/R switch on the AUDIO portion of panel 8 or 12 is set to ICS T/R and the MODE switch on either panel is set to PTT. The PTT position bypasses the automatic voice sense circuits. The Commander or LM Pilot can close a push-to-talk switch (on the attitude controller assemblies or the umbilicals) and speak into a microphone. The push-to-talk switch energizes the VOX key relay, providing a ground for activation of the power control logic in the DSEA. In the energized state, this relay routes an enabling signal through the RECORDER switch and is applied to the recorder electronics. The audio signal generated by the astronaut is conditioned by the SPA and fed to the recorder for transfer to tape. For operation in the semiautomatic mode, the MODE switch is set to VOX. With the switch set to this position, the VOX trigger circuit is enabled. The VOX sense circuit senses voice input from within the cabin or from the communications receivers and feeds this signal to the VOX trigger circuit. When the two inputs are coincident, the trigger is activated. Setting the MOD switch to ICS/PTT results in a continuous key for the recorder. When operating in this mode, recorder operation is manually controlled with the RECORDER switch (panel 12). With the MODE switch in the ICS/PTT position, the RECORDER switch must be in the OFF position until voice is to be taped. The RECORDER TAPE talkback (panel 12) indicates tape motion during recording.

The DSEA consists of signal-conditioning electronics, a power supply, control logic, and a tape-motion amplifier. The signal-conditioning electronics accepts audio and TCD signals and conditions them before they are fed to the record head. Audio signals routed through the astronaut's intercommunications bus are applied to a voice amplifier that provides the band-pass filtering, impedance matching, and signal amplification required to drive the record head. Simultaneously with the voice input, TCD is supplied (as binary inputs) from the serial time code generator in the PCMTEA. A DSEA time-correlation data modulator accepts and converts serial binary-coded decimal data to frequency-coded data for recording. The binary input signals modulate a voltage-controlled oscillator to produce an output frequency of 4, 175 cps, with a binary 1 input; 4,625 cps, with a binary 0 input. These voice and timing signals are mixed with the outputs of a reference oscillator that supplies a constant 5.2-kc signal for subsequent use in the DSEA test station, servoamplifiers, and a bias oscillator, which provides a 33-kc signal that eliminates nonlinear response in playback of voice and data. This permits recording multiplexed data on each of the four tracks. The control logic provides transport control, automatic track switching for the four tape passes, and starting and stopping of the DSEA. The tape transport uses a closed-loop capstan drive system with controlled tension in the record/reproduce head area. Dual capstans with a high angle of tape wrap provide sufficient driving friction without the use of pinch rollers. The drive motor in the tape transport is of the single-phase, 400-cycle, hysteresis, synchronous type with constant speed (+0.1% of input power). During recording, the reproduce head reads the recorded track and, through the tape-motion amplifier, supplies the signal that operates the TAPE talkback

2.9.4.5.1 Power Supply.

The DSEA power supply consists of a power converter and voltage regulator, which provide regulated d-c power for all DSEA electronics. The power converter conditions 115-volt, 400-cps, power supplied from control logic circuits, to voltage levels of +17 and -8 volts dc. The +17 volts operates relays in control logic and tape-motion monitor circuits. It is also applied to the voltage regulator, along with the -8 volts. A-C power for the capstan drive motor is supplied from a tap on the primary winding of a transformer (T1). The voltage regulator regulates the +17 and -8 volts dc from the power converter to +11.5 and -4.5 volts, respectively. These voltage levels are required for DSEA electronic circuitry.



2.9.5 PERFORMANCE AND DESIGN DATA.

The performance and design data for the IS are given in table 2.9-4.

Table 2.9-4. Instrumentation Subsystem - Performance and Design Data

Pulse-code-modulation and iming electronics assembly	
Height	6.72 inches
Width	5.12 inches
Length	19.75 inches
Weight	23.0 pounds (approximate)
Power requirements	
Excitation	20 to 32 volts dc
Consumption	11 watts
Operating temperature (ambient)	+30° to +130° F
Reliability	
Component calibration	Amplifiers, analog-to-digital converter, and all analog circuitry with functions common to 10 or more measurements
Calibration levels	4.250 volts, 0.750 volts
Accuracy	±9 millivolts on high level
High-level analog signals	
Number of channels	277
Normal bit rate (51.2 kilobits per second)	200 channels externally programmed, 77 channels internally redundant
Reduced bit rate (1.6 kilobits per second)	113 channels externally programmed, 41 channels internally redundant
Signal levels	0 to 5 volts
Analog error	0.5% (maximum)
Sampling rate	1, 10, 50, 100, or 200 samples per second
Bits formed per channel input	8
Parallel digital signals	
Number of channels	75
Normal bit rate	1, 10, 50, 100, or 200 samples per second
Reduced bit rate	1 sample per second

Table 2.9-4. Instrumentation Subsystem - Performance and Design Cata (cont)

Pulse-code-modulation and timing electronics assembly (cont)

Parallel digital signals (cont)

Signal levels

Binary 1

+3.5 to +10 volts

Binary 0

-0.5 to +1.5 volts

Bits per output word

8, 16, or 32

Sampling sequence for 8-, 16-, and

Sequential, with eight most significant bits first

32-bit input words

Serial digital signals

Number of channels

2 channels, serial by bit

Signal levels

Binary 1

+3.5 to +10 volts

Binary 0

-0.5 to +1.5 volts

Word length

One 24-bit channel One 40-bit channel

Normal bit rate

50 samples per second

Reduced bit rate

None

1,024-kpps input signals

Type

Square wave

Amplitude

7±3 volts, peak to peak

NRZ output

Bit rate

51.2 or 1.6 kilobits per second

Signal levels

Binary 1

+6±0.5 volts

Binary 0

0.0 to +0.5 volt

RZ output

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Bit rate

51.2 or 1.6 kilobits per second

Signal levels

4.5±2 volts, peak to peak

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Table 2.5 4 Instrumentation Subsystem - Performance and Design Data (cont)

Pulse-code-modulation and timing electronics assembly (cont) Data rate timing output Frequency 51.2 or 1.6 kpps (selected by remote switching) Signal levels 4.5±2 volts, 1 eak to peak Subcarrier reference output Frequency 51.2 pps Signal levels 10-kilohm output load 0.0 to +0.5 volt and +6 \pm 0.5 volts 100-ohm output load 4.5+2 volts, peak to peak Subframe sync pulse output Frequency 1 pps Signal levels 4.5±2 volts, peak to peak 512-kpps timing output signals Frequency 512 kpps Signal levels 0.0 to 0.5 volt and $\pm 3.0 \pm 0.5$ volts 6.4-kpps timing output signals Frequency 6,400 pps Signal levels 0.0 to 0.5 volt and +3.0 ±0.5 volts 1.6-kpps timing output signals Frequency 1,600 pps Signal levels 0.0 to 0.5 volt and +3.0 ±0.5 volts 10-pps timing output signal Frequency 10 pps 0.0 to 0.5 volt and \pm 3.0 \pm 0.5 volts Signal levels 1024-kpps timing output signal Frequency 1024 kpps Signal levels 0. 0 to 0.5 volt and $+3.0\pm0.5$ volts Time-correlation data 40-bit serial start Frequency 1 pps Signal level 4.5[±]1 volts, peak to peak

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Table 2.9-4. Instrumentation Subsystem - Performance and Design Data (cont)

Pulse-code-modulation and timing electronics assembly (cont) Time-correlation data (cont) 40-bit serial stop Frequency 1 pps Signal level 4.5±1 volts, peak to peak 40-bit serial sync Frequency 2 kpps Signal level 4.5[±]1 volts, peak to peak 24-bit serial sync Frequency 1.2 kpps Signal level 4.5[±]1 volts, peak to peak 24-bit serial stop Frequency 1 pps Signal level 4.5-1 volts, peak to peak Low-bit-rate split-phase data outputs Bit rate 1.6 kilobits per second Signal levels +6.0 ±0.5 volts (up level) +0.0 to 0.5 volt (down level) Analog-to-digital conversion Each analog sample 8-bit binary word output Full-scale input to ADC 11111110 Zero input 00000001 Greater than full scale 11111111 Less than zero 00000000 Signal-conditioning electronics assembly Height 8.0 inches Width 5.25 inches Length 23.90 inches Weight ERA-1 35.44 pounds ERA-2 35.25 pounds

Page

Table 2.9-4. Instrumentation Subs, 3'em - Performance and Design Data (cont)

Signal-conditioning electronics

assembly (cont)

Power requirements

Excitation

28 volts de

Consumption

ERA-1

16.04 watts

ERA-2

14.23 watts

Thermal characteristics

An efficient thermal path exists between heat-producing sources

within subassemblies and an external heat sink.

Environmental limits

Vibration

8. 1g rms from 20 to 2, 000 cps

Acceleration

8g

Shock

15g sawtooth

Temperature

Operating

+30° to +130° F

Nonoperating

-65° to +160° F

D-C amplifiers

Inputs

Unipolar mode

0 to 200 millivolts dc and 0 to 5 volts dc

Bipolar mode

-100 millivolts to -2.5 volts dc and +100 millivolts to +2.5

volts de

Output

0 to 5 volts dc (four single channels)

Attenuators

Inputs

Unipolar mode

0 to 5 volts dc (minimum attenuation)

0 to 40 volts dc (attenuation of 8)

Bipolar mode

-2.5 to +2.5 volts dc and -20 to +20 volts dc

Output

0 to 5 volts dc (four single channels)

AC-to-dc converters

Input frequency

380 to 840 cps

Output

0 to 5 volts dc (three single channels)

Analog signal isolating buffer

Input

0 to 5 volts de

Output

0 to 5 volts dc (four single channels)

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Table 2.9-4. Instrumentation Subsystem - Performance and Design Data (cont)

Signal-conditioning electronics assembly (cont)

assembly (cont)

Discrete signal isolating buffers

504-2

Turn-on voltage

0.5 to 2.5 volts dc

Output voltage

0.to 5 volts dc (10 dual channels)

504-3-4

Output voltage

0 to 5 volts dc (12 dual channels)

504-5

Output voltage

0 to 5 volts dc (12 single channels)

Frequency-to-dc converter

Input frequency

380 to 420 cps

Output

0 to 5 volts dc

Resistance-to-dc converters

Resistance changes

665 to 2, 795 ohms (-200° to +500° F)

Output

0 to 5 volts dc (four dual channels)

Phase-sensitive demodulators

Output

0 to 5 volts de

Caution and warning electronics assembly

Height

7.0 inches

Width

6.750 inches

Length

11.750 inches

Weight

19.75 pounds (approximate)

Power requirements

Excitation

28 volts de

Consumption

13 watts

Internally generated

+4, +23, +12, +9, -3, +7, and 16.3 volts dc, rectified

Three 34-volt, zero-to-peak, 10-kc, center-tapped square waves

One 15.5-volt, zero-to-peak, 10-kc, center-tapped square wave

Two 10-kc reference signals

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Table 2.9-4. Instrumentation Subsystem - Performanc, and Design Data (cont)

Environmental limits	
Temperature	
Operating	+35° to +135° F
Nonoperating	-65° to +160° F
Vibration	8. lg rms from 20 to 2, 000 cps
Shock	15g sawtooth
Acceleration	8g
Input signals	
Caution	
Discrete	26
Analog	23
Inhibit	3
Enable	4
Warning	
Discrete	10
Analog	22
Inhibit	7
Enable	2
Indicator reset	
Caution	10
Warning	1
Thrust chamber assembly (TCA) logic	
Command (discrete or analog)	16
Response (discrete)	16
Output signals	
Caution light	17
Warning light	14
Component caution light	2
Talkback	8
MASTER ALARM pushbutton/light	2

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Table 2.9-4. Instrumentation Libsystem - Performance and Design Data (cont)

Caution and warning electronics assembly (cont)

Inputs

Analog signals

0.5 to 5.0 volts de

Discrete, malfunction

3.4 to 6.0 volts dc

Discrete, no malfunction

0 to 0.5 volt de

Out-of-limit inputs

Delay time (input to output): 0.5 second maximum

Telemetry output

Malfunction

Relay contacts open

No malfunction

Relay contacts closed

Voltage limits

Upper

Output signal generated when preset voltage is exceeded

Lower

Output signal generated when preset voltage is exceeded

Data storage electronics assembly

Height

2.05 inches

Width

4.0 inches

Length

6.22 inches

Weight

38 ounces

Power requirements

Power supply input

115±2.5 volts rms, 400 cps, single phase

Reset command

28±4 volts dc

VOX command input

28+4-8 volts dc

Output

+17 volts dc unregulated, +11.5 volts dc regulated 26.0

volts rms

Magnetic heads

Two record/reproduce heads to provide four tracks

Voice record amplifier

Input level

-3 to +7 dbm

Frequency response

 $300 \text{ cps to } 3,000 \text{ cps } \pm 3 \text{ db}$

Bias oscillator

Output frequency

 $33 \text{ kc} \pm 10\%$

Output level

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5±1 milliamperes

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Taul : 2.9-4. Instrumentation Subsystem - Performance and Design Data (cont)

Data storage electronics assembly (cont)

Tape

Speed

0.6 inch per second

Total recording time

10 hours (maximum)

Length of tape between sensor

450 feet (minimum)

strips

Power Source

AC

115±2.5 volts rms

DC

28 volts de

DSEA transport

Speed error

0.05 of input power deviation

Start time

100 milliseconds after receipt of VOX trigger

Stop time

300 milliseconds after cessation of VOX trigger

Record time

Total of 10 hours

End of tape

Automatically sensed

Time-correlation data

Input

Serial NRZ-C (100 bits per second)

Input levels

Binary 1

6±1 volts

Binary 0

-0.5 to 1.5 volts

2.9.6 OPERATIONAL LIMITATIONS AND RESTRICTIONS.

The operational limitations and restrictions for the IS are as follows:

- The PCMTEA, SCEA, and signal sensors (for preconditioned transducers) must be warmed up for 5 minutes after coolant-loop stabilization, before use. If the 5-minute warmup period is not allowed, the accuracy of data will be uncertain.
- Total recording time (voice keyed) for the DSEA voice tape recorder is 10 hours. The DSEA will not record voice after 10-hour use.

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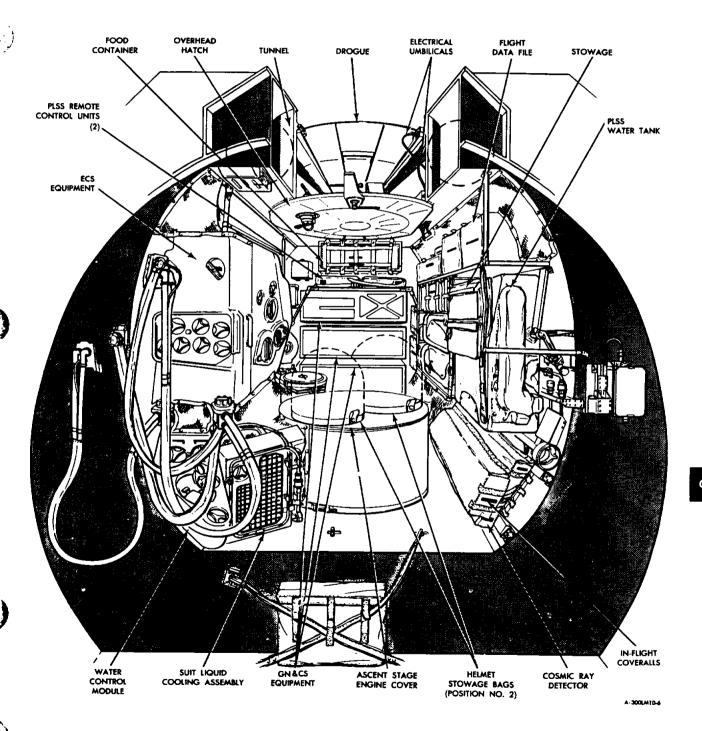


Figure 2.11-19. LM Cabin Interior, Aft View

CREW PERSONAL EQUIPMENT

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